Appendix A CDC Select Agent List

The CDC Category Listing of Potential Bioterrorism Agents

The CDC has identified several agents that are potential bioterrorism threats.
They are divided into categories based on several criteria.
The category description and agents are listed below.

Category A

- high priority
- easily transmitted from person-to-person
- high mortality rates
- potential for major public health impact
- can cause public panic/social disruption
- requires special action for public health preparedness

Anthrax
Bacillus anthracis

Botulism
Clostridium botulinum toxin

Plague
Yersinia pestis

Smallpox
Variola major

Tularemia
Francisella tularensis

Viral hemorrhagic fevers
Ebola, Marburg,
Lassa, Machupo

Category B

- second highest priority
- moderately easy to disseminate
- moderate morbidity and low mortality rates
- specific diagnostics required
- enhanced disease surveillance

Brucellosis
Brucella spp.

Glanders
Burkholderia mallei

Melioidosis
Burkholderia pseudomallei

Psittacosis
Chlamydia psittaci

Q Fever
Coxiella burnettii

Typhus fever
Rickettsia prowazekii

Viral encephalitis
Venezuelan Equine Encephalitis
Eastern Equine Encephalitis
Western Equine Encephalitis

Toxins
Clostridium perfringens
Ricinus communis
Staph. aureus

Food Safety
Salmonella spp.
E. coli O157:H7

Water Safety
Vibrio cholerae
Cryptosporidium parvum

Category C

- third highest priority
- emerging pathogens
- could be engineered for mass dissemination
- available
- easy production and dissemination
- potentially high morbidity and mortality
- major health impact

Nipah
Nipah virus

Hantavirus
Hantavirus

Other Important Zoonotic Diseases

Transmissible Spongiform Encephalopathy
BSE, CWD, Scrapie

Rift Valley Fever virus

Hendra virus

West Nile Fever
West Nile virus

Appendix B CWA & TIC List

CWA See Figure 2 in Chemical and Biological Defense Primer

TIC See attached list

Chemical and Biological Defense Primer

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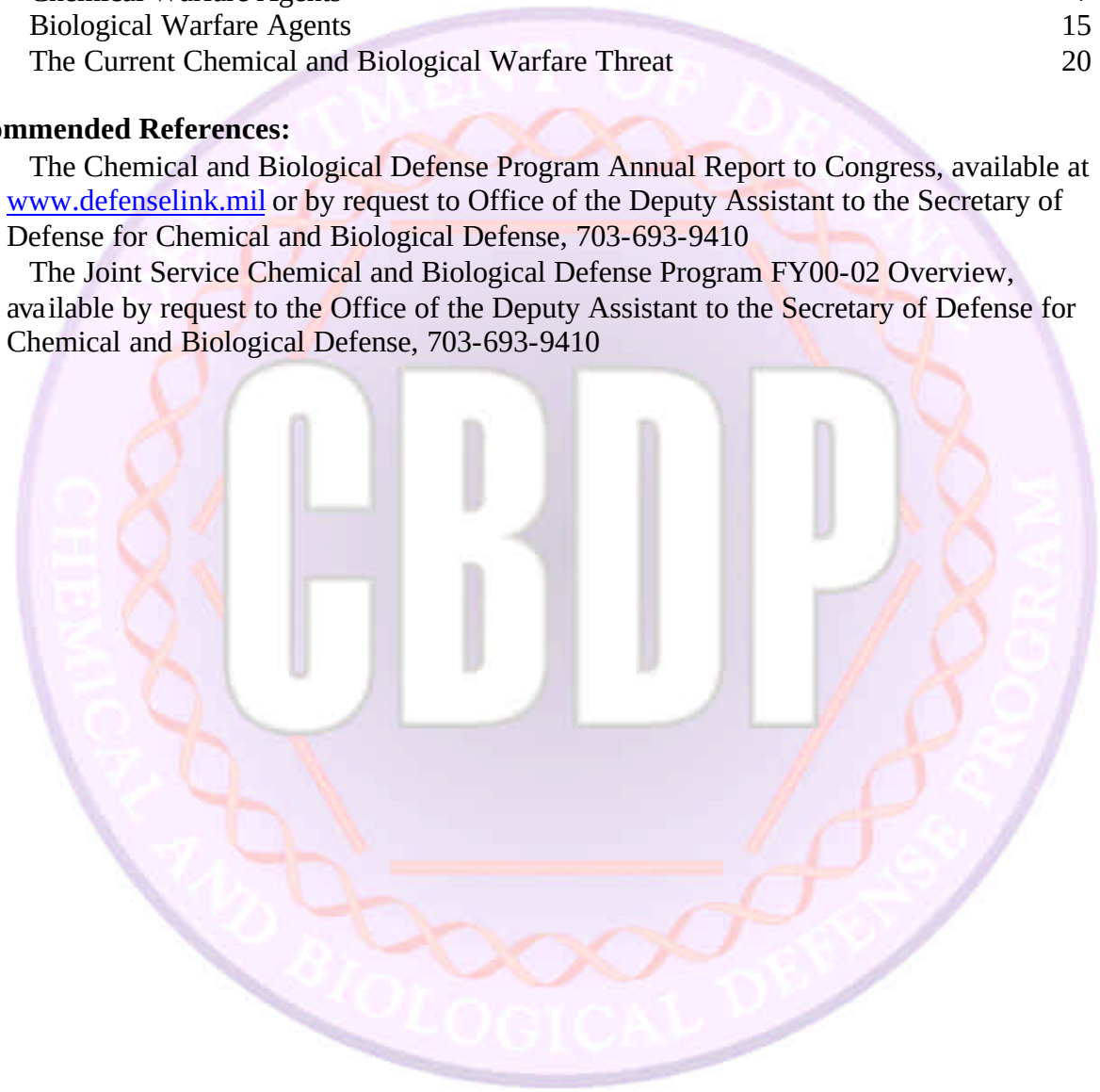
Table of Contents

Recommended References:

- The Chemical and Biological Defense Program Annual Report to Congress, available at www.defenselink.mil or by request to Office of the Deputy Assistant to the Secretary of Defense for Chemical and Biological Defense, 703-693-9410
- The Joint Service Chemical and Biological Defense Program FY00-02 Overview, available by request to the Office of the Deputy Assistant to the Secretary of Defense for Chemical and Biological Defense, 703-693-9410



Chemical and Biological Defense Primer- Introduction

The potential use of Chemical or Biological Weapons (CBW) against American citizens and assets is one of the most disturbing threats facing the United States today. Both chemical and biological weapons are considered "Weapons of Mass Destruction" or WMD. WMD are those weapons that are capable of a high order of destruction and/or of being used in such a manner as to destroy large numbers of people. While the term "WMD" typically encompasses nuclear, chemical, and biological weapons, this report will focus on the CBW threat because the potential threat from chemical or biological weapons is generally considered more likely than the threat from nuclear weapons.

The CBW threat is significant because it is multidimensional in terms of diversity of potential users and the circumstances of that use. CBW can be used by rival nation states or terrorist organizations and can be employed on the battlefield or directed against the US homeland.

Traditionally, the perceived threat of CBW was directed toward US combat troops or American installations in foreign countries. Today, however, use of CBW against domestic US targets is becoming a more credible threat. Enhancing this credibility is the fact that CBW threats to the US are no longer restricted to rival nation-states. In this current environment, CBW capabilities are rapidly expanding, becoming more accessible to organized groups or individuals wishing to threaten the United States and its citizens.

Terrorist use of chemical or biological weapons is among the most alarming of emerging transnational threats.[1] Both the absence of other dominating global powers and the existence of overwhelming United States military capability greatly limit a terrorist's options. Increasing numbers of terrorist groups are looking to make use of asymmetric measures to accomplish their goals.

In an effort to stifle the proliferation of chemical and biological weapons, the international community adopted the Chemical Weapons Convention (CWC) and Biological Weapons Convention (BWC)[2]. Despite these efforts, shortcomings within the treaties continue to exacerbate the problems of proliferation. The language of the treaties focuses on large developmental programs in sovereign states. They were not intended to deal with the small quantities of chemical or biological agents that might be used by terrorists. In addition, the treaties do not effectively regulate "dual use" items. The CWC does not address many Toxic Industrial Chemicals (TICs) that might be used as weapons. For example, methyl isocynate, the deadly gas that killed thousands in Bhopal, India, is not included in the schedules of chemicals listed in the CWC. Other gases, such as chlorine or phosgene, are not considered effective

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[1] "Terrorism" is defined in Joint Pub 1-02 as "The calculated use of unlawful violence or threat of violence to inculcate fear; intended to coerce or to intimidate governments or societies in the pursuit of goals that are generally political, religious, or ideological."

[2] The Biological Weapons Convention was presented to the Senate by President Nixon in 1972, ratified by the Senate in 1974, and signed by President Ford in 1975. The treaty entered into force in March of 1975. Negotiations to strengthen the BWC into a legally binding instrument has not been agreed to by the United States.

battlefield agents but might be ideal in certain terrorist scenarios. Similarly, biological agents could be readily available under the guise of pharmacological research. Finally, the treaties were developed at a time when these weapons were considered difficult to create or control. However, numerous advances in technology or genetic engineering may provide the ability to produce and manipulate these agents, making them effective tactical or operational weapons.

The international nonproliferation regime is increasingly challenged by numerous factors. A growing trend towards indigenous production of CBW related equipment decreases the effectiveness of sanctions and other national and multinational tools designed to counter proliferation. Similarly, the "dual use" umbrella makes detection of a burgeoning program extremely difficult. Proliferation control regimes may be further eroded by the acquisition of CBW and related equipment by terrorist organizations.

CBW Characteristics

Weapons of Mass Destruction may be nuclear, chemical, or biological weapons, and includes their associated delivery systems. This report focuses only on chemical and biological weapons and their effects. Unlike nuclear or conventional weapons, chemical and biological weapons cause incapacitation or death solely through their interaction with the human. There are no blast, shock, thermal, or pressure effects that are involved with chemical or biological weapons. Chemical weapons are poisons that affect the living system through the skin, eyes, lungs, blood, nerves, or other organs. Biological weapons are disease-causing microorganisms such as bacteria, rickettsia, and viruses. Toxins are chemicals produced by living organisms and behave like chemicals in their interactions with humans, plants, or animals.

Rudimentary chemical and biological weapons require minimal technology and are available to any state desiring to produce them. The most basic chemical warfare agent, mustard gas (levinstein mustard), was first synthesized in 1823. Advanced chemical or biological weapons, including high purity nerve agents, are available to almost any country or organizational regime with chemical engineering, pharmaceutical, or biotechnology industries.

The United States currently faces a serious potential threat from chemical and biological weapons. Nations capable of developing and delivering CBW could use these weapons to achieve political or military objectives, or CBW could be used as an adjunct to conventional combat power or as a weapon of terror against civilians. The following table provides a summary of the general characteristics of chemical and biological weapons.

Characteristics	Chemical	Biological
Area Affected	Relatively Small	Can Be Very Large
Detectability	Difficult	Very Difficult
Time to Detect & Identify	Seconds	Tens of Minutes
Time until Onset of Effects	Normally Minutes	Normally Days
Medical Treatment	Limited	Can Be Effective

Figure 1. Characteristics of CBW

The fall of the Berlin Wall and the collapse of the Soviet Union have not eliminated the threat to the US; they have only modified it. This threat, which was previously a bi-polar global confrontation between the United States and the Soviet Union and their proxies, now involves a wider range of potential conflicts or other military operations. Such regional challenges heighten the possibility of a confrontation involving an organizational regime in possession of chemical or biological weapons. The proliferation of CBW increases the likelihood of their employment in regional conflicts where U.S. or other western interests are involved.

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CBW technology is spreading. Developing nations are increasingly coming to possess these weapons or the means to develop them through either overt or covert direct transfer. The potential for their use can range from blackmail or acts of terrorism during peace to employment during conflict or war. The various CBW programs worldwide were largely developed during the 1960s, reached maturity with their battlefield employment during the 1980s and are undergoing continued expansion. Today, access to chemical and biological technology is growing due to a variety of factors to include: the economic conditions in the former Soviet Union, the globalization of biotechnology and pharmaceutical industries, and scientific, engineering, and technical personnel exchanges that have facilitated the exchange of information.

The unique nature of chemical and biological weapons requires an integrated defensive posture to counter the threat. The threat from chemical and biological weapons is unique not in that they cause death or incapacitation—they are unique in how they cause it. Chemical and biological weapons invoke a fear among the attacked party, especially if they are unprepared, because these weapons may be invisible, thus striking without warning. When they are visible, such as a smoke or vapor cloud, they are amorphous and cannot be dodged like a bullet. They can literally seep through cracks and crevices.

While chemical and biological weapons are in themselves designed to be deadly, it is the method and accuracy of their delivery that determines the severity of the damage. The ultimate effectiveness of these weapons is determined by the following factors, regardless of the circumstances of their use:

- Agent delivery
- Doses on target
- Downwind dispersal
- Doses inhaled or absorbed
- Symptoms, and
- Performance degradation.

Agent delivery — The means to deliver chemical and biological weapons is almost unlimited. On the battlefield, delivery systems may include cruise or ballistic missile, artillery, rockets, mortars, mines, bombs, sprayers, or spray tanks. Defenses against agent delivery include missile defenses and counterforce (pre-emptive) strikes. Terrorist attacks are much more complex. Delivery systems are limited only by the imagination, and may include poisoning food or water supplies, using dummy fire extinguishers, crop dusters, *etc.*…

The dispersal of chemical and biological weapons can take a wide variety of forms. Probable means of weapons employment include:

- Off-target (upwind) attacks using agent aerosol disseminators moved along paths perpendicular to wind direction. Means of delivery could be aircraft, UAVs, cruise missiles, boats/submersibles, or ground vehicles. Such attacks also could be achieved with multiple source detonation/spray devices covertly placed upwind from the target and triggered remotely or by timing devices.

- On-target attacks using various forms of agent containing fused munitions that explosively disseminate or spray agent at or near ground level. Among these munitions are ballistic and cruise missile warheads, aircraft ordnance, tube and rocket artillery, and naval gunfire.
- Area-denial attack using persistent (generally chemical) agents laid down in a heavy pattern with the intention of contaminating ground areas and water-crossing points that enemy forces may attempt to traverse. Means of delivery include aircraft ordnance, artillery, and mines.

Doses on target — Once the agent is delivered, it is critical to determine how much agent is delivered on target and in what form (vapor, liquid, *etc.*…) From an adversary's perspective, this is the most critical (and perhaps the most difficult) factor in employing chemical or biological weapons. This factor highlights the complexity in using CB agents as weapons. Some agents are extremely lethal, yet difficult to form into an aerosol (*e.g.*, botulinum toxin); other agents have very low lethality, yet may be selected as a weapon because of the ease to form it into an aerosol (*e.g.*, tularemia.) Defenses may include early warning systems or tactics to allow the avoidance of exposure.

Downwind dispersal — The dispersal of agent will depend on the type of agent, the delivery system, and geographical and meteorological conditions. A thickened vesicant agent on a cold, windless night will pose little downwind hazard. The hazard will be limited almost exclusively to the immediate area of weapon impact. However, under optimal conditions a biological agent (such as anthrax) delivered from a single sprayer can create a lethal downwind hazard area of over a thousand square kilometers. The nature of this delivery allows adversaries to deliver agent many kilometers from the intended target site, thus increasing the difficulty in preventing or detecting agent release. Detection and warning systems are needed to defend against this hazard. Decontamination systems may be used to prevent the spread or re-aerosolization of agents.

Doses inhaled or absorbed — Once doses have been delivered on target or carried downwind, personnel are exposed to hazards of chemical and biological agents by inhalation or percutaneously (through the skin.) Biological and toxin agents primarily pose an inhalation hazard; through they may have effect through open wounds or eye contact. Chemical agents may have lethal effect through both contact and by inhalation. Defenses against this aspect of the threat include masks, suits, gloves, and collective protection systems and shelters.

Symptoms — If personnel are exposed to chemical or biological agents, symptoms may occur. Symptoms may be immediate (for example, nerve agents) or delayed by several days (for example, many biological agents.) Symptoms range from nausea and dizziness to paralysis and death. (See Figures 2 and 3 for details.) Vaccines may prevent or minimize the effects of exposure to chemical or biological agents. Therapies and drugs may be available for treatment where vaccines are not available.

Performance degradation — If defenses are not effective and personnel develop symptoms resulting from agent exposure, the performance of our forces may be degraded, perhaps significantly. Effective casualty management can reduce the number of casualties and

increase the return to duty. Training can reduce degradation from the defensive equipment or the psychological fear of CB agents.

In a battlefield setting, several additional elements can come into play. Future scenarios for chemical and biological warfare use against engaged forces are not expected to differ from those envisioned historically in conjunction with the large-scale chemical and biological warfare programs that a number of countries have pursued. Of the targets listed below, those in the first category tend to be most susceptible to infectious agents, which have a relatively slow onset of effect but larger area coverage. Targets in the second and third categories are vulnerable to a wide variety of chemical and biological agents. The targets in the fourth category are most susceptible to chemical and toxin agents, which have a relatively rapid onset of effect but smaller area coverage per unit weight of agent.

I. *High-value, large-area facilities/targets within or outside of theater*: leadership, diplomatic, military headquarters, industrial, commercial, population centers.

II. *Theater support military facilities*: command and control, troop barracks, air bases, missile launch sites, naval ports, logistical transfer/storage facilities.

III. *Military assets near engagement areas*: troop convoys, staging areas, drop zones, airstrips, air defense systems, artillery support bases, naval task forces.

IV. *Forces in engagement*: infantry, amphibious, mechanized/armor.

Aimed at certain critical nodes in the military infrastructure of the United States, either domestically or abroad, chemical or biological weapons could disrupt the execution of military objectives. Therefore, it is imperative that the United States has an ability to operate effectively in a contaminated environment while simultaneously being able to identify threat agent(s), treat injured personnel, and remediate the contaminated area.

United States forces, which have to operate in these regions, face, therefore, the combined threats of both conventional chemical agents and weapons and the potential for exposure to chemicals produced as an element of the regions chemical industry. Scale of operation is the main discriminator between military uses of weapons and chemicals released from chemical plants by saboteurs or collateral damage resulting from military operations. The chemical plant at Tuzla is a prime example; the chemical storage tanks there have a capacity to hold over 2 times as much chlorine as was released by Germany in their first ever chemical attack, which killed or injured over 5,000 people in a span of just 15 minutes. If released in an area like Tuzla, such a catastrophic release could have a significant effect on military operations, as well as affecting future humanitarian, political, and economic considerations at all levels ranging from local to international.

Chemical Warfare Agents

A chemical agent is defined as a chemical substance intended for use in military operations to kill, seriously injure, or incapacitate through its physiological effects. Lethal chemical agents are those that primarily cause death among exposed personnel. They include nerve, choking and blood agents. Blister agents damage any tissue that they contact. They could be lethal under certain conditions, but skin, eye, or respiratory damage is their main casualty-producing effects. Blister agents could also be employed to contaminate terrain, facilities, or materiel

Chemical agents are classified as non-persistent, as in the case of the G-series of nerve agent, or persistent, as with the nerve agent VX and blister agents. The persistency of a chemical agent refers to the duration of its effectiveness under certain conditions after its dissemination. Generally speaking, persistent agents can present a contact hazard as well as an inhalation hazard. Non-persistent agents present only an inhalation hazard. In order to achieve good ground coverage when dispersed from a high altitude with persistent CW agents, the dispersed droplets must be sufficiently large to ensure that they fall within the target area and do not get transported elsewhere by the wind. This can be achieved by dissolving polymers (e.g., polystyrene or rubber products) in the CW agent to make the product highly viscous or thickened. The result is that the persistence and adhesive ability increases, complicating decontamination.

Class of Agent	Symbol	Symptoms	Effects	Rate of Action
Nerve	GA GB GD GF VX	Difficulty breathing, sweating, drooling, convulsions, dimming of vision.	Incapacitates at low concentrations. Kills in sufficient dosage. VX is persistent and a contact hazard. The other agents are non-persistent and present an inhalation hazard.	Vapors—seconds to minutes Skin—2 to 18 hours
Blood	AC CK	Rapid breathing, convulsions, and coma.	Kills in sufficient dosage. Non-persistent and an inhalation hazard.	Immediate
Blister	HD HN HL L	No early symptoms. Searing/stinging of eyes and skin.	Blisters delayed hours to days; eyes and lungs affected more rapidly. Immediate pain, delayed blisters. Persistent and a contact hazard.	Vapors—4 to 6 hours Skin—2-48 hours
Choking	CG DP	Difficulty breathing; tearing of the eyes.	Damages and floods lungs. Death can result. Non-persistent and an inhalation hazard.	Immediate to 3 hours

Figure 2. Chemical Agents and Their Effects

Characteristics

Nerve Agents

Nerve agents disrupt the transmission of impulses within the nervous system. They are stable and easily dispersed, highly toxic and have rapid effects whether they are absorbed through the skin, eyes, or inhaled. All nerve agents in their pure state are colorless liquids. Readily available industrial chemical processes can manufacture them. The ingredients--precursors--of nerve agents, although controlled by international treaties such as the Chemical Weapons Convention (CWC), are easily obtainable. The most common nerve agents are:

- Tabun, GA
- Sarin, GB
- Soman, GD
- Cyclosarin, GF
- VX

Nerve agents are extremely toxic and possess a very rapid effect. The nerve agent, either as a gas, aerosol or liquid, enters the body through inhalation or through the skin. Poisoning may also occur through consumption of liquids or foods contaminated with nerve agents. The manner in which they enter the body impacts on the time required for the nerve agent to start having an effect. It also influences the symptoms developed and, to some extent, the sequence of the various symptoms. Generally, the poisoning works faster when the agent is absorbed through the respiratory system than via other routes. This is because the lungs contain numerous blood vessels and the inhaled nerve agent can therefore rapidly diffuse into the blood circulation and thus reach the target organs.

Symptoms of nerve agent poisoning include: increased production of saliva, chest pain, miosis (constriction of the pupil), headache, tiredness, slurred speech, hallucinations, nausea, difficulty breathing, coughing, cramping and vomiting, local tremors, convulsions, and loss of consciousness. The toxic effect depends on both the concentration of nerve agent in the air inhaled and the time of exposure.

As previously stated, nerve agents act rapidly. If medical treatment is to have a beneficial effect, it must be started immediately. Auto-injectors containing antidotes to nerve agents are the commonly encountered form of treatment. An additional auto-injector can be given to victims of nerve agents if their situation does not improve within ten minutes. Subsequently, the victim should be treated by qualified medical staff who should initially inject additional atropine and an anti-convulsant drug such as diazepam. In cases of severe poisoning by nerve agents, large doses of atropine (grams) may be required. Recovering from severe nerve agent poisoning requires at least two weeks and is characterized by difficulty in sleeping, amnesia, difficulties in concentrating, anxiety, and muscular weakness.

Blood Agents

Most blood agents are non-persistent and are primarily absorbed into the body by breathing. There are two primary blood agents – hydrogen cyanide (AC) and cyanongen chloride (CK). Both gaseous and liquid hydrogen cyanide can also enter the body through the skin. Its

high volatility probably makes hydrogen cyanide difficult to use in warfare since there are problems in achieving sufficiently high concentrations outdoors. On the other hand, the concentration of hydrogen cyanide may rapidly reach lethal levels if it is released in confined spaces.

Symptoms of cyanide poisoning vary and depend on, for example, route of poisoning, total dose, and the exposure time. If hydrogen cyanide has been inhaled, the initial symptoms are restlessness and increased respiratory rate. Other early symptoms are giddiness, headache, palpitations and respiratory difficulty. These are followed by vomiting, convulsions, respiratory failure and unconsciousness. If the poisoning occurs rapidly as a result of extremely high concentrations in the air, symptoms may not develop prior to death. Today, there is no medical antidote against cyanide poisoning. The current treatment given to victims is based on encouraging and speeding-up the body's own ability to excrete cyanide and to bind cyanide in the blood, either by methemoglobin formation or by fixation with cobalt compounds.

Blister Agents

Blister agents received their name due to the nature of the wounds they cause. However, since blister agents (also called "vesicants") also cause severe damage to the eyes, respiratory system and internal organs, they could also be described as tissue-injuring agents. The effect of blister agents are delayed and the first symptoms do not occurring until 2 to 24 hours after exposure. The severity of a blister agent burn is directly related to the concentration of agent and duration of its contact with the skin. Blister agents can also be used to contaminate supplies or facilities. These agents are persistent and may be employed as a gas or liquid. Blister agents are divided into three types: mustards, arsenicals, and urticants.

In its pure state, mustard agent is colorless and almost odorless. The name "mustard" was given to the blister agent "H" as a result of an earlier production method that yielded an impure mustard-smelling product. Mustard agent is also claimed to have a characteristic smell similar to rotten onions. However, the sense of smell is dulled after only a few breaths so that the smell can no longer be distinguished. In addition, mustard agent can cause injury to the respiratory system in concentrations that are so low that the human sense of smell cannot distinguish them.

Whether in a gas or a liquid, mustard agent attacks the skin, eyes, lungs and gastro-intestinal tract. Internal organs may also be injured, as a result of agent being absorbed through the skin or lungs and transported into the body. Delayed effects are a characteristic of mustard agent. Mustard agent gives no immediate symptoms upon contact and consequently a delay of between two and twenty-four hours may occur before pain is felt and the victim becomes aware of what has happened. By then, however, cell damage has already occurred.

Symptoms of mustard agent poisoning extend over a wide range. Mild injuries consist of aching eyes with abundant flow of tears, inflammation of the skin, irritation of the mucous membrane, hoarseness, coughing and sneezing. Normally, these injuries do not require medical treatment. Severe injuries that are incapacitating and require medical care may involve eye injuries with loss of sight, the formation of blisters on the skin, nausea, vomiting and diarrhea together with severe respiration difficulty.

There is no treatment or antidote that can affect the basic cause of mustard agent injury. Instead, efforts must be made to treat the symptoms. By far the most important measure is to rapidly and thoroughly decontaminate the patient and thereby prevent further exposure. This decontamination will also decrease the risk of exposure to staff. Clothes are removed; the skin is decontaminated with a suitable decontaminant and washed with soap and water. If hair is contaminated, then it must be shaved off. Eyes are rinsed with water or a physiological salt solution for at least five minutes.

In medical treatment, efforts are made to control infections by means of antibiotics. Pain can be eased by local anesthetics. After skin injuries have healed, it may be necessary to perform plastic surgery. Lung injuries are treated with bronchodilatory treatment. Medicine to relieve coughing and also cortisone preparations may be used. Eye injuries are treated locally with painkillers and with antibiotics if required. Despite treatment, inflammation and light sensitivity may remain for long periods.

Arsenicals. The arsenicals are a group of blister agents having arsenic as a central atom in their chemical structure. Arsenicals produce much the same injuries to the skin and mucus membrane as mustard, but have the added effect of being a systemic poison. Arsenicals are colorless to brown liquids that evaporate more quickly than mustard and have a fruity or geranium-like odor. They are much more dangerous as liquids than as vapors. Immediate decontamination to remove liquid agent is necessary in contaminated individuals, but is not necessary for exposure to vapors unless pain is present. Sneezing and irritation to the upper respiratory tract can result from exposure to the vapors. There are three main arsenicals: Lewisite (L), mustard-lewisite mixture (HL), and phenyldichloroarisine (PD).

Urticants. Urticants are blister agents that cause an immediate, severe burning sensation followed by intense pain and then a feeling of numbness. The most common urticant is phosgene oxime (CX). It has a disagreeable, penetrating odor and can appear as a colorless crystalline solid, or as a liquid. CX causes violent irritation to the mucous membrane of the eyes and nose. An individual exposed to CX will first show an area of pale skin surrounded by a red ring where the agent came in contact with the skin. A welt resembling a bee sting will form within 30 minutes. The area will turn brown within 24 hours, and a scab will form within a week. Healing could be delayed for as long as two months. Any skin exposed to CX should be decontaminated as soon as possible by flushing the area with large amounts of water.

Choking Agents

Choking agents are lethal chemical warfare agents that are designed to cause death in an exposed individual. These agents injure unprotected personnel mainly in the respiratory tract (nose, throat, and lungs). These agents will “choke” an unprotected person. Upon exposure, membranes swell and secrete fluid, the lungs fill with this fluid, and death results from lack of oxygen. The term for such a death is “dry land drowning.” There are two choking agents: Phosgene (CG) and diphosgene (DP). CG is a chemical agent with short agent-cloud duration. Diphosgene (DP) is also a colorless gas with an odor similar to CG. DP has a stronger tearing effect than CG and thus has less of a surprise value when used against personnel. Its symptoms and effects are similar to CG.

Toxic Industrial Chemicals (TIC)

Although they are not chemical warfare agents, TICs still can still pose a threat to US interests. While many times less lethal than traditional chemical warfare agents, there is a re-emergent threat from TICs. These compounds generally have a median lethal dose 10 to 100 times less toxic than the nerve agents, but are more widely available. NATO International Task Force 25 (ITF-25) has identified the potential use of TICs as weapons in the report Hazard for Industrial Chemical: Reconnaissance of Industrial Hazards. ITF-25 ranked chemicals according to their hazard index. ITF-25 considered that for a given chemical to present a hazard in a military situation, the chemical must be present in sufficient quantity in the area of concern, must exhibit sufficient toxicity by inhalation, and must normally exist in a state that could give rise to an inhalation hazard. The following table list TICs that received a high hazard index ranking.

Ammonia	Arsine	Boron trichloride
Boron trifluoride	Carbon disulfide	Chlorine
Diborane	Ethylene oxide	Fluorine
Formaldehyde	Hydrogen bromide	Hydrogen chloride
Hydrogen cyanide	Hydrogen fluoride	Hydrogen sulfide
Nitric acid, fuming	Phosgene	Phosphorus trichloride
Sulfur dioxide	Sulfuric acid	Tungsten hexafluoride

Figure 3: List of High Hazard TICs According to the ITF

The number and likelihood of exposures of U.S. forces to occupational and environmental chemicals are both increasing. In areas where U.S. forces are likely to be deployed, the likelihood of exposures to multiple environmental chemicals is high. Although many industrialized nations have strict controls on the release of industrial chemicals, less-developed nations may not have the political or institutional infrastructure to provide protection from exposures to harmful substances.

During military deployments, these exposures could be even higher as a result of the breakdown of local governments, damage to industrial facilities, or the use of operational areas as dumping grounds for hazardous industrial waste. Defense personnel may be exposed to large chemical releases from industrial accidents at home or abroad, from deliberate acts of enemy forces or terrorists, from unintentional operational releases, and from natural disasters. Chlorine gas, for example, is used and stored by a large number of industrial-process facilities, especially water treatment facilities, and is also widely used as a reagent in the manufacture of chlorinated organic materials and inorganic chlorides and chlorates. Thus, chlorine storage tanks are likely to be present in an urban or industrial environment. Chlorine is a powerful irritant, both in the upper and the lower respiratory tract.

Railroad tank cars and tanker trucks also carry a variety of highly toxic chemical agents and reactive intermediate agents for chemical synthesis. These cars and trucks are moving targets of opportunity. The potential release of toxic chemical intermediates from moving or stationary sources continues to be a cause for concern in many parts of the world. The disastrous release of

methyl isocyanate near the city of Bhopal, India, in 1984 remains an icon for potential releases from chemical plants that store or use toxic intermediates.

Another source of contamination during deployment might be through U.S. or allied attacks on enemy CB manufacturing or storage sites. Great care must be taken to identify these locations and assess the potential damage from the release of CB agents.

Agent Production:

Every country with a chemical weapons development program is working on blister and nerve agents. The base chemicals and production procedures used are similar to those used in producing modern pesticides. The production process of blister agents is relatively simple, consisting of one or two steps, followed by production purification. Once purified, blister agents are highly stable; in fact some high purity mustard agent is still in bulk storage that was produced by the United States during World War II. Nerve agents, on the other hand, are more complicated to make, requiring a series of steps.

Commercially available industrial chemicals are used as starting materials, or precursors, in the production of these chemicals agents. Precursors are manufactured by a large number of countries, including a growing number of developing nations, making the diversion of chemicals to chemical agent production difficult to restrict. Most precursors have multiple high-volume legitimate uses.

The cost, availability of raw materials or precursors, stability, and the difficulty of providing medical treatment to affected personnel are also important factors in any decision to manufacture chemical agents. Standard chemical agents, such as the nerve agents tabun, sarin, VX, and soman, and the blister agents mustard and Lewisite, all have predictable properties and can be made by a number of well-known synthetic routes and thus have become the agents of choice for countries developing chemical warfare weapons. The technical challenge of preparing the agent varies. Mustard is the easiest to make, and VX is the most difficult.

CW Weaponization:

Weaponization of CW agents can be accomplished in numerous ways. The most common methods are the free-flight munitions that are fired at or dropped on a target. Weaponization can be in unitary or binary form, and the larger munitions can contain submunitions. Spray tanks can also be used to disseminate agent from an aircraft or from a ground-based aerosol generator.

Most conventional munitions can be modified to deliver lethal or non-lethal chemical agents. Typical chemical munitions may include aerial bombs, artillery rockets, artillery shells and mortar rounds, grenades, mines, missile warheads, and sprayers and spray tanks. These normally contain burster charges surrounded by bulk-filled agent. The burster ruptures the munitions and causes the agent to be disseminated as a stream or cloud of small droplets.

Air- or ground-based aerosol generators can be used for more controlled dissemination of CW agents. Spray tanks can be used to disseminate agents from aircraft, and ground-based aerosol generators can be used to disseminate agents.

Chemical munitions usually fall into one of two categories: unitary or binary. A unitary munition contains the agent itself, while binary munitions contain two agent precursors that mix in the munitions and form agent before or during flight. Unitaries are able to deliver more agent per munitions, but binaries—because they contain the less toxic precursors—are safer for storage. The U.S. stockpile is made up mostly of unitary munitions, scheduled to be destroyed in accordance with the Chemical Disposal Stockpile Plan before the year 2004.

CW agents can also be carried in submunitions or bomblets. The submunitions are ejected from the primary munitions some distance above the ground, landing on the ground in a random pattern and detonating, covering an area larger and more evenly than if deployed in a bulk-filled munitions.

Terrorist organizations may choose dispersal methods that are less dependant on technology. Terrorists may utilize homemade explosive or spray devises. In the 1995 sarin attack on the Tokyo subway system, the Aum Shinrikyo cult used umbrella tips to puncture plastic bags containing the agent.

No matter what dispersal method is selected, however, the weather, terrain, and buildings will all have an effect on the chemical agent once it has been employed.

Strong wind, heavy rain or temperatures below freezing may reduce effects of a chemical agent. After the attack, the weather will be of great importance for the respiratory risks expected at different distances from the target. Similarly, weather conditions influence the effect of ground contamination. After an attack, the primary cloud will drift with the wind. Wind velocity will be decisive for how long it will take for the primary cloud to pass the given place. High wind velocity implies a short time of passage and thus fewer injuries to unprotected persons, whereas low wind velocity will lead to more injuries. Consequently, a weak wind may cause effects at greater distances than strong winds.

Wind velocity also naturally influences how fast the primary cloud moves. If the wind is gentle, then there are better opportunities to provide warning in time. In very weak winds, however, the gas cloud will not move very far. In addition, the wind direction varies widely in such situations, which is why a circular area must be alerted in an attack with CW agents. The concentration in the primary cloud may also decrease in cold weather and particularly if the temperature is lower than freezing. This depends on a smaller amount of CW agents evaporating during dispersal, which also implies that the share of ground contamination will be greater.

Precipitation also reduces the concentration since some of the gas/aerosol is "washed" away by wet deposition. A major problem during the winter may be that contaminated snow on shoes and clothes is taken into shelters, vehicles or buildings. Once in the warmth, the CW agent will evaporate and may cause concentrations of gas. Light rain will cause ground contamination to be more dangerous since the pores in the soil become clogged and prevent the substance from

penetrating down into the soil. Heavy rain, however, will flush off ground contamination whereas heavy snow will cover it. In both cases, the contact risk is decreased.

Woodland and undulating terrain give shorter danger distances for the primary cloud since the wind will be exposed to greater turbulence. Woodland also adsorbs a certain amount of gas and aerosol through dry deposition. In or close to the target area, however, woodland, depressions, pits and narrow streets may lengthen the effect of an attack. Gas and aerosol will be retained in these areas, particularly in situations of weak wind and stable stratification. The longest danger distances are obtained if the cloud passes over plains or lakes, or follows the contours of a valley.

The effect of a passing cloud of gas/aerosol will be delayed inside tents, buildings and vehicles. Owing to the lower air exchange in such places, it will take longer for the cloud to penetrate. A certain amount of the CW agent will be taken up and bound on walls and other surfaces, which also contributes to decreases in concentration. Consequently, it may be expected that there is a certain reduction in the effect of a passing cloud of gas. In ordinary buildings, the protection can be improved by closing doors and windows, turning off the ventilation and sealing all cracks with tape.

Ground configuration is also of importance for the contact risk in ground contamination. A dry, hard but porous surface, e.g., asphalt or concrete, will lead to fewer contact risks. On soft ground, e.g., grass, moss, sand or snow, it is easier to come into contact with CW agents that have penetrated the underlying surface. In dense woodland, the ground contamination is reduced and becomes uneven since the falling droplets are caught to some extent in the crowns of the trees. Terrain covered by bushes, on the other hand, may lead to major risks of contact.

Biological Warfare Agents

Biological warfare is defined as the employment of pathogens or toxins to produce casualties in humans or animals and damage to plants or material. There is a distinction made between pathogens and toxins. Pathogens are living organisms, while toxins are the inert by-products of living organisms. Pathogens are disease-producing microorganisms, such as bacteria, viruses, rickettsia, or fungi. They are either naturally occurring, or altered by mutation or genetic engineering. Toxins are poisons produced by the metabolic activities of living organisms. Classical biological agents include anthrax, botulinum toxin, smallpox, tularemia, Q fever, ricin, viral hemorrhagic fevers, and plague.

Biological agents are inherently more toxic then chemical agents on a weight-for-weight basis and can provide broader coverage per pound of payload. Moreover, they are potentially more effective because most are naturally occurring organisms - such as bacteria and viruses - which are self-replicating and have specific physiologically targeted effects, whereas chemical agents are manufactured chemicals that disrupt physiological pathways in a general way. The potential range of materials used for biological agents is limitless, but a biological agent must possess a number of the following characteristics to be militarily useful.

Requirements.
(1) Consistently produce a given effect (death, disability or plant damage).
(2) Be manufacturable on a large scale.
(3) Be stable under production and storage condition, in munitions, and during transportation.
(4) Be capable of efficient dissemination.
(5) Be stable after dissemination.

Desirable characteristics:
(1) Possible for the using forces to protect against.
(2) Difficult for a potential enemy to detect or protect against.
(3) A short and predictable incubation period.
(4) A short and predictable persistency if the contaminated area is to be promptly occupied by friendly troops.
(5) Capable of: (a) infecting more than one kind of target (for example, man and animals) through more than one portal of entry. (b) Being disseminated by various means. (c) Producing desired psychological effects.

Figure 4: Military Usefulness of Biological Agents

Biological weapons (BW) can be directly or indirectly employed against personnel, plants, animals, or material. Foods, especially uncooked food as in a salad bar, water supplies, or facilities can be rendered unsafe or unfit for use or consumption through contamination. People can be infected either directly by the employment of a BW agent or indirectly through secondary contamination from an exposed individual, as in smallpox and plague.

PATHOGEN	ROUTES OF INFECTION*	DISSEMINATION	UNTREATED MORTALITY (%)	INCUBATION PERIOD	TREATMENT
Anthrax	S,D,R	Aerosol	S - less than 25% R – approaches-100%	1-4 days	Antibiotics (limited effectiveness after symptoms develop)
Plague	V,R	Aerosol or Vectors	Bubonic - 50% Pneumonic - 50-90%	2-3 days	Antibiotics
Tularemia	V,S,R	Aerosols	30 - 40%	1-10 days	Antibiotics
Q Fever	V,R	Covert or Aerosol	less than 1%	14-26 days	Antibiotics
Brucellosis	D, R	Aerosol	<6%	5-21 days	Antibiotics
Viral Hemorrhagic: Fevers (*e.g.*, Ebola, Marburg, *etc.*…)	DC, uncertain	Aerosol	40-90%	4-21 days	Supportive care only

*S - skin, D- digestive, R - respiratory, V - vector, DC - direct contact.

Figure 5. Characteristics of Selected Pathogens

TOXIN	NATURAL SOURCE	RATE OF ACTION	LD50 (MG/KG)*	EFFECT
Botulinum	Clostridium botulinum bacteria	1 to 12 hours	0.0003 to 0.01	Dilated pupils, double vision, dry mouth, paralysis
Tetanus	Clostridium tetani bacteria	1 to 12 hours	0.0025 in humans	Muscle spasms, frequently in the jaw muscles
Palytoxin	Palythoa soft corals	5 minutes	0.08	Muscle contractions, heart irregularities, rigid paralysis
Batrachotoxin	South American frog	5 mins. to 1 hour	0.1 to 2	Loss of coordination, numbness, headache, irregular heart rate, respiratory paralysis
Ricin	Castor Bean	5 mins. to 1 hour	3.0 (oral)	Nausea, vomiting, cramps, bloody nose, diarrhea, difficulty in breathing, twitching
Saxitoxin	Shellfish	5 mins. to 1 hour	5-12 (oral), 1 (aerosol)	Tingling, numbness, weakness, flaccid (limp) paralysis
Tetrodotoxin	Puffer fish	5 mins. to 1 hour	30 (oral)	Vomiting; tingling; numbness; lack of muscle control; loss of voice; paralysis, especially of the arms and legs
Tricothecene (T2) mycotoxin	Fusarium mold on infected grain	1 to 12 hours	50 to 240 (aerosol)	Itching, tingling, vomiting, hemorrhaging, bloody diarrhea
Staphylococcus Enterotoxin Type B (SEB)	Staphylococcus aureus bacteria	1 to 12 hours	200 (aerosol)	Vomiting, cramps, nausea, diarrhea, severe weakness

** Lethal Doses based on mouse model, unless otherwise noted.*

Figure 6. Characteristics of Selected Toxins

Both overt and covert attacks have the potential to cause large numbers of casualties. Most of the means of protection against a chemical inhalant attack are largely effective against a biological inhalant attack (particularly the mask, although it is not a foolproof protective device). Recognize, however, that awareness that an attack is occurring is key, and this is clearly problematic.

If the type of pathogen is not quickly determined and medical treatment not readily available, very large numbers of casualties can be expected. From the time of an attack to the incubation period, zero casualties would report to medical personnel for treatment. Depending on the agent used, a peak in casualties would take place within a few days (for anthrax) or up to two months (for brucellosis) and could quickly overload medical personnel and facilities.

A biological attack may require the treatment of those individuals who were exposed but have not yet exhibited symptoms. The extreme effects of a biological attack can be effectively mitigated. Bleach, hot soapy water, and sunlight are the best, most readily available means of decontamination.

Early detection is the key to mitigation of the effects of a biological attack or incident. Rigorous implementation of the following activities is "best practice" for preventing or detecting biological incidents:

- Water and food inspection programs
- Environmental monitoring programs
- Disease monitoring programs
- Proper physical protection (facilities and personal protective equipment)
- Forensic identification means
- Vaccine and diagnostic programs
- Training and awareness programs
- Good intelligence and event notification programs

Agent Production:

Biological agents are a strategic as well as operational threat. They can, depending on their intended use, cause lethal, disabling, contagious or noncontagious types of casualties. Biological agents can be effectively employed against military targets such as headquarters, ship or aircraft crews, and troop concentrations, as well as civilian population centers. Missiles, aerosol generators, aerial line sprays or covert means, could be used to deliver agents. Some agents, including microorganisms and toxins, are capable of widespread infection and debilitation.

To a country or terrorist group considering such a course of action, there are advantages to biological weapons. There are few reliable biological detection devices readily available and, biological agents are normally invisible to the human senses. The delay in onset of symptoms could make it difficult to identify the time and place of attack. A biological attack could be attributed to a natural outbreak or epidemic, thus providing the attacking country with grounds for plausible denial.

There is little to distinguish a vaccine or pharmaceutical plant from a biological agent facility. Virtually all equipment, technology, and materials needed for biological agent production are dual use. The technical skills required to start and run a program are commensurate with the basic procedures of microbiology, with any required additional knowledge easily gained through training courses available from equipment suppliers or at scientific meetings. Any nation with a modestly developed pharmaceutical industry has the necessary technical infrastructure to produce biological warfare agents. The equipment used to produce biological agents is dual-use in nature, and a laboratory devoted to biological warfare research will be generally similar to a facility engaged in peaceful research activities. The terrorist organization *Aum Shinrikyo* demonstrated the potential ease of weaponizing biological agents (in their case, botulinum toxin) by cultivating strains of C*lostridium botulinum* from soil taken from one of their member's farms.

Recent advances in biotechnology research have increased the potential for developing new biological agents that have optimal weapons potential and reduce the time to develop new agents from basic research to mass production. In addition, the increasing technical complexity of biotechnological studies will make distinguishing between peaceful research and that directed toward biological warfare purposes even more difficult. This will allow an increasing number of nations to take advantage of advanced biotechnology developments.

It is not necessary for a country or terrorist organization to maintain large stockpiles of biological weapons as sufficient quantities of agent can be quickly produced using small starter cultures. Iraq has admitted to conducting an offensive biological warfare program, as well as weaponizing botulinum toxin and anthrax. Ricin, T2 mycotoxin and smallpox have also been produced with intended targets being Israel and the coalition forces. While Iraqi biological weapon facilities were damaged during the Gulf War, critical production equipment escaped destruction, thus opening the possibility for production to resume in the future.

<u>Biological Agent Weaponization</u>:

There are two methods of dissemination:

- Line source: This technique is most effective using a dispersal means (a truck or air sprayer) moving perpendicular to the wind during an inversion (in which air temperature increases with altitude, holding surface air and pollutants down; incursions normally occur at dawn, dusk, or night).

- Point source: This technique uses small bomblets deployed in a saturation mode. The saturation technique overcomes the meteorological requirements for line source dissemination. Agents may be introduced into buildings' heating-ventilation-air conditioning systems or via food or water contamination. Small packages or envelopes may also be used to disperse the agent.

Many of the technologies and processes used for weaponizing chemical warfare agents can be applied to biological warfare agents. Aerial bombs, rockets, artillery, missile warheads

(with or without submunitions), and spray systems can be used to deliver biological warfare agents. The method of delivery depends on operational objectives and capabilities and strategic and tactical doctrine.

Both aerosol attacks and food and water contamination attacks have the potential to cause large numbers of casualties. While it is individually useful, area decontamination after a biological attack may not provide further reduction in casualties, depending on the agent involved. A special problem is associated with contamination that tends to settle in basements and other low areas, rubble piles, and similar collections of debris, or into porous surfaces. This concentration could extend the lethality period of biological agents.

The Current Chemical and Biological Warfare Threat[4]

Northeast Asia

North Korea has been pursuing research and development related to biological warfare since the 1960s. Pyongyang's resources presently include a rudimentary (by Western standards) biotechnology infrastructure that is sufficient to support the production of limited quantities of toxins, as well as viral and bacterial biological warfare agents. In the early 1990s, an open press release by a foreign government referred to applied military biotechnology work at numerous North Korean medical institutes and universities dealing with the anthrax, cholera, plague and smallpox pathogens. North Korea possesses a sufficient munitions-production infrastructure to accomplish weaponization of BW agents. North Korea does possess a sufficient munitions production infrastructure to accomplish weaponization of BW agents.

By comparison, North Korea's chemical warfare program is believed to be mature and includes the capability, since 1989, to indigenously produce bulk quantities of nerve, blister, choking and blood chemical agents as well as a variety of filled munitions systems. North Korea is believed to possess a sizable stockpile of chemical weapons, which could be employed in offensive military operations against the South. In fact, the United States believes that North Korea has some long-range artillery deployed along the demilitarized zone (DMZ) and ballistic missiles, some of which could deliver chemical warfare agents against forward-based U.S. and allied forces, as well as against rear-area targets.

North Korea has also devoted considerable scarce resources to defensive measures aimed at protecting its civilian population and military forces from the effects of chemical weapons. Such measures include extensive training in the use of protective masks, suits, detectors, and decontamination systems. Though these measures are ostensibly focused on a perceived threat from U.S. and South Korean forces, they could also support the offensive use of chemical weapons by the North during combat. North Korea has yet to sign the Chemical Weapons Convention (CWC) and is not expected to do so in the near-term, due to intrusive inspection and verification requirements mandated by the agreement.

China possesses an advanced biotechnology infrastructure as well as the requisite munitions production capabilities necessary to develop, produce and weaponize biological agents. China has consistently claimed that it never researched, produced, or possessed any biological weapons and would never do so. Nevertheless, China's declarations under the voluntary BWC declarations for confidence building purposes are believed to be inaccurate and incomplete, and there are some reports that China may retain elements of its biological warfare program.

China is believed to have an advanced chemical warfare program that includes research and development, production and weaponization capabilities. While China claims it possesses no chemical agent inventory, it is believed to possess a moderate inventory of chemical agents. It has a wide variety of potential delivery systems for chemical agents, including cannon artillery, multiple rocket launchers, mortars, land mines, aerial bombs, SRBMs, and MRBMs. Chinese military forces most likely have a good understanding of chemical warfare doctrine, and its

[4] From the "2001 Chemical and Biological Defense Annual Report to Congress," pp. 5-10, July 2001

forces routinely conduct defensive chemical warfare training. Even though China has ratified the CWC, made its declaration, and subjected its declared chemical weapons facilities to inspections, DoD believes that Beijing has not acknowledged the full extent of its chemical weapons program.

South Asia

India has many well-qualified scientists, numerous biological and pharmaceutical production facilities, and biocontainment facilities suitable for research and development of dangerous pathogens. At least some of these facilities are being used to support research and development for biological warfare defense work. India has ratified the BWC.

India is an original signatory of the CWC. In June 1997, it acknowledged that it had a dedicated chemical warfare production program. This was the first time India had publicly admitted that it had a chemical warfare effort. India also stated that all related facilities would be open for inspection, as called for in the CWC, and subsequently, it has hosted all required CWC inspections. While India has made a commitment to destroy its chemical weapons, its extensive and well-developed chemical industry will continue to be capable of producing a wide variety of chemical agent precursors should the government change its policy.

Pakistan is believed to have the resources and capabilities to support a limited biological warfare research and development effort. Pakistan may continue to seek foreign equipment and technology to expand its biotechnology infrastructure. Pakistan has ratified the BWC and actively participates in compliance protocol negotiations for the treaty.

Pakistan ratified the CWC in October 1997 and did not declare any chemical agent production or development. Pakistan has imported a number of dual-use chemicals that can be used to make chemical agents. These chemicals also have commercial uses and Pakistan is working towards establishing a viable commercial industry capable of producing a variety of chemicals, some of which could be used to make chemical agents. Chemical agent delivery methods available to Pakistan include missiles, artillery, and aerial bombs.

The Middle East and North Africa

Iran has a growing biotechnology industry, significant pharmaceutical experience and the overall infrastructure to support its biological warfare program. Tehran has expanded its efforts to seek considerable dual-use biotechnology materials and expertise from entities in Russia and elsewhere, ostensibly for civilian reasons. Iran's biological warfare program began during the Iran-Iraq War. Iran is believed to be pursuing offensive biological warfare capabilities and its effort may have evolved beyond agent research and development to the capability to produce small quantities of agent. Iran has ratified the BWC.

Iran ratified the chemical Weapons Convention (CWC), and in a May 1998 session of the CWC Conference of the States Parties, Tehran, for the first time, acknowledged the existence of a past chemical weapons program. Iran admitted developing a chemical warfare program during the latter stages of the Iran-Iraq war as "deterrent" against Iraq's use if chemical agents against Iran. Moreover, Tehran claimed that after the 1988 cease-fire, it "terminated" its program.

Nevertheless, Iran has continued its efforts to seek production technology, expertise and precursor chemicals from entities in Russia and China that could be used to create a more advanced and self-sufficient chemical warfare infrastructure. In the past, Tehran has manufacture and stockpiled blister, blood and choking chemical agents, and weaponized some of these into

artillery shells, mortars, rockets, and aerial bombs. It also is believe to be conducting research on nerve agents. Iran could employ these agents during a future conflict in the region.

Prior to the Gulf War, *Iraq* developed the largest and most advanced biological warfare program in the Middle East. Though a variety of agents were studied, the Iraqis declared anthrax, botulinum toxin, and aflatoxin to have completed the weaponization cycle. Iraq also admitted that during the Persian Gulf War it had deployed biological agent-filled munitions to airfields and that these weapons were intended for use against Israel and coalition forces in Saudi Arabia. Iraq stated that it destroyed all of these agents and munitions in 1991, but it has provided insufficient credible evidence to support this claim.

The UN believes that Baghdad has the ability to reconstitute its biological warfare capabilities within a few weeks or months, and in the absence of UNSCOM or other international inspections and monitoring during 1999 and 2000, DoD is concerned that Baghdad again may have produced some biological warfare agents.

Since the Gulf War, Baghdad has rebuilt key portions of its industrial and chemical production infrastructure; it has not become a state party to the CWC. Some of Iraq's facilities could be converted fairly quickly to production of chemical warfare agents. Following OPERATION DESERT FOX, Baghdad again instituted a rapid reconstruction effort on those facilities to include former dual-use chemical warfare-associated production facilities, destroyed by U.S. bombing. In 1999, Iraq may have begun installing or repairing dual-use equipment at these or other chemical warfare –related facilities. Previously, Iraq was known to have produced and stockpiled mustard, tabun, sarin, and VX, some of which likely remain hidden. It is likely that an additional quantity of various precursor chemicals also remain hidden.

In late 1998, UNSCOM reported to the UN Security Council that Iraq continued to withhold information related to its chemical program. UNSCOM inspectors, which indicated that Iraq had not consumed as many chemicals munitions during the Iran-Iraq War as had been declared previously by Baghdad. This document suggests that Iraq may have an additional 6,000 chemical munitions hidden. Similarly, UNSCOM's discovery in 1998 of evidence of VX in Iraqi missile warheads showed that Iraq had lied to the international community for seven years when it repeatedly said that it had never weaponized VX.

Syria has a limited biotechnology infrastructure but could support a limited biological warfare effort. Though Syria is believed to be pursuing the development of biological weapons, it is not believed to have progressed much beyond the research and development phase and may have produced only pilot quantities of usable agent. Syria is a signatory to, but has not ratified, the BWC.

Syria is not a state party to the CWC and has had a chemical warfare program for many years, although it has never used chemical agents in a conflict. Damascus already has a stockpile of the nerve agent sarin that can be delivered by aircraft or ballistic missiles. Additionally, Syria is trying to develop the more toxic and persistent nerve agent VX. In the future, Syria can be expected to continue to improve its chemical agent production and storage infrastructure.

Libya has ratified the BWC, but has continued a biological warfare program. This program has not advanced beyond the research and development stage, although it may be capable of producing small quantities of biological agent. Libya's program has been hindered by

the country's poor scientific and technological base, equipment shortages, and a lack of skilled personnel, as well as by UN sanctions in place from 1992 to 1999.

Following the suspension of UN sanctions in April 1999, Libya wasted no time in reestablishing contacts with foreign sources of expertise, parts and precursor chemicals for its program. Clearly, Tripoli has not given up its goal of reestablishing its offensive chemical warfare ability and continues to pursue an indigenous chemical warfare production capability.

Prior to 1990, Libya produced about 100 tons of chemical agents—mustard and some nerve agent—at a chemical facility at Rabta. However, it ceased production there in 1990 due to intense international media attention and the possibility of military intervention, and fabricated a fire to make the Rabta facility appear to have been seriously damaged. Libya maintains that the facility is a pharmaceutical production plant and announced in September 1995 that it was reopening the Rabta pharmaceutical facility. After 1990, the Libyans shifted their efforts to trying build a large underground chemical production facility at Tarhunah. However, the pace of activity there has slowed, probably due to increases international attention.

Russia

The FSU offensive biological warfare program was the world's largest and consisted of both military facilities and civilian research and development institutes. According to Ken Alibek, the former Deputy Director of BIOPRPARAT, the principal Soviet government agency for biological weapons research and development, by the early 1970s, the Soviet Union had developed a biological warfare employment doctrine, where biological weapons were categorized as strategic or operational.

The Russian government has publicly committed to ending the former Soviet biological weapons program and claims to have ended the program in 1992. Nevertheless, serious concerns remain about Russia's offensive biological warfare capabilities and the status of some elements of the offensive biological warfare capability inherited form the FSU.

Since the breakup of the Soviet Union, more extensive downsizing and restructuring of the program have taken place. Many of the key research and production facilities have taken severe cuts in funding and personnel. However, some key components of the former Soviet program may remain largely intact and may support a possible future mobilization capability for the production of biological agents and delivery systems. Despite Russian ratification of the BWC, work outside the scope of legitimate biological defense may be occurring now that selected facilities within Russia, and the United States continues to receive unconfirmed reports of some ongoing offensive biological warfare activities.

Moscow has acknowledged the world's largest stockpile of chemical agents of 40,000 metric tons of agent. The Russian chemical warfare agent inventory consists of a comprehensive array of blister, choking, and nerve agents in weapons and stored in bulk. These agents can be employed by tube and rocket artillery, bombs, spray tanks, and SRBM warheads. In addition, since 1992, Russian scientists familiar with Moscow's chemical warfare development program have been publicizing information on a new generation of agents, sometimes referred to as "Novichoks." These scientists report that these compounds, some of which are binaries, were designed to circumvent the CWC and to defeat Western detection and protection measures.

As a state party to the CWC, Russia is obligated to declared and destroy its chemical weapons stockpile and to forego the development, production, and possession of chemical

weapons. However, DoD believes that the Russians probably have not divulged the full extent of their chemical agent and weapon inventory.

PROLIFERATION

The United States faces a number of regional proliferation challenges. Many of these are detailed in the January 2001 report published by the Office of the Secretary of Defense, *Proliferation: Threat and Response*. In the Middle East, Iran continues with a concerted effort to acquire an independent production capability for all aspects of its chemical weapons program and has reduced dependency on foreign assistance. Nevertheless, Iran has continued its efforts to seek production technology, expertise and precursor chemicals from entities in Russia and China that could be used to create a more advanced and self-sufficient chemical warfare infrastructure. Iran is also pursuing a program to purchase dual-use biotech equipment from other countries, ostensibly for civilian uses. Russia is a key source of biotechnology for Iran. Russian entities have been key sources of biotechnology and chemicals for Iran. Russia's world-leading expertise in biological and chemical weapons makes it an attractive source for Iranians seeking technical information and training on biological and chemical warfare agent production processes.

Proliferation of chemical and biological warfare technology in South Asia also raises several important issues. In the past, India has exported a wide array of chemical products, including Australia Group-controlled items, to numerous countries of proliferation concern in the Middle East. The controlled items include specific chemical agent precursors, pathogens with biological warfare applications, and dual-use equipment which can be used in both chemical and biological warfare programs. Pakistan, on the other hand, may continue to seek foreign equipment and technology to expand its biotechnology infrastructure. In addition, Pakistan has imported a number of dual-use chemicals that can be used to make chemical agents.

In North Africa, following the suspension of UN sanctions in April 1999, Libya wasted no time in reestablishing contacts with foreign sources of expertise, parts, and precursor chemicals for its program. Clearly, Tripoli has not given up its goal of reestablishing its offensive chemical warfare ability and continues to pursue an indigenous

Australia Group

The proliferation of chemical and biological warfare related technology remains a critical threat to peace and stability throughout the world. One mechanism through which industrialized countries have agreed to control the proliferation of key chemical and biological warfare related technologies is the Australia Group. The Australia Group (AG) is a consortium of countries organized to slow the proliferation of chemical and biological warfare programs by harmonizing national export controls and sharing information on trends in proliferation, entities of concern, chemical and biological warfare (CBW) terrorism, and licensing and enforcement experiences. The AG is not a treaty, and hence has no formal guidelines, charter, or constitution. Initial efforts of this group began in June 1985 and focused on precursor chemicals used in the manufacture of chemical agents. However, convinced of the threat posed from biological weapons, AG countries subsequently agreed, in December 1992, to also control the sale of items that most likely could be used to develop biological agents and weaponry. The AG developed control lists of dual-use chemical- and biological-related materials that are particularly suited for use in CBW. These lists currently contain 54 chemical precursors (34 of these chemicals are on the Chemical Weapons Convention (CWC) Schedules); 93 human, animal, and plant biological pathogens and toxins; and dual-use chemical- and biological-related production equipment. The listed items include animal and plant pathogen that could be used for anti-crop and anti-animal biological warfare.

chemical warfare production capability. In addition, with suspension of UN sanctions, Libya's ability to acquire biological-related equipment and expertise will increase.

OUTLOOK

In the next 10 years, the threat from the proliferation of CBW weapons will certainly increase. This will result from the development of chemical and biological agents that are more difficult to detect and from the adoption of more capable delivery systems.* DoD expects that more states with existing programs will master the production processes for complete weapons and will be less dependent on outside suppliers. States will be more proficient at incorporating chemical or biological agents into delivery systems and will be focusing on battlefield training as well as employment strategy and doctrine. Therefore, the threshold of some states to consider using these capabilities may be lowered.

DoD does not expect significant increases in the number of government-sponsored offensive CBW programs. Nevertheless, the United States and its allies must be alert to this possibility as well as to the apparent growing interest in CBW on the part of sub-national groups such as terrorist organizations. Any nation with the political will and a minimal industrial base could produce CBW agents suitable for use in warfare. Efficient weaponization of these agents, however, does require design and production skills usually found in countries that possess a munitions development infrastructure or access to such skills from cooperative sources. On the other hand, crude agent dispersal devices could be fabricated by almost any nation or group. Such weapons might be capable of inflicting only limited numbers of casualties; nevertheless, they could have significant operational repercussions due to the psychological impact created by fears of CBW agent exposure.

* An assessment of potential new biological agents that may challenge U.S. forces is in a DoD report to Congress entitled *Advances in Biotechnology and Genetic Engineering: Implications for the Development of New Biological Warfare Agents*, June 1996.

Chemical	Rate of Onset	Persists in Environment	Toxicity Thresholds (ppm/hour) *impairment* / *fatality*	BDO/ Mask Effective	Odor	Related hazards/ Source/ Use	Field Detection: *Sensidyne tube (#)*	Field Detection: *205Aseries Miran SapphiRE*	Symptoms *(from inhalation and dermal contact)*	Decontamination and Treatment
Allyl alcohol *(colorless liquid)*	Immediate	Days-weeks, +	7.7 / 22	?	Mustard-like	Rapidly absorbed through skin highly flammmable with caustic fumes; used as contact pesticide, plastic/perfume manufacture	Not available (liquid)	Not available (liquid)	<u>General Mild Health Effects:</u> - Nausea, dizziness; headaches; chills; coughing, choking, throat irritation <u>Specific and More Severe Effects:</u> *Eyes:* - Irritation; tearing/watering; pain; intolerance to light (e.g. from Hydrogen Sulfide) *Skin (particularly if liquid contact)*: - Irritation; burning; blisters (eg with Hydrogen Fluoride); vesiculation (nitric & sulfuric acid); dermatitis; and frostbite (e.g. Acryonitrile) *Respiratory Tract/Lungs:* - Breathing difficulty.respiratory distress; laryngeal spasm (e.g., from hydrogen chloride or hydrogen bromide); **pulmonary edema** *Chest/Heart:* - chest pain; tachardia (rapid heartbeat) *Systemic; Blood* - Cyanotic (blue skin from lack Oxy to blood) (e.g, from SO2, SO3, NO2, ethylene oxide): - Convulsions/seizures - Hemolytic anemia; kidney damage (Arsine) <u>Additional Chemical Specific Symptoms:</u> *pink/froth sputum:* Ammonia *mucoid frothy sputum*: SO2,SO3, NO2 *peculiar taste*: Ethylene oxide *asphyxia:* Acrylonitrile *metal taste & or garlic breath*:Hydrogen Selenide ----------→	<u>Decontamination</u>: - Flush (15 min) eyes & skin with water; - Soap optional after initial water rinse <u>Treatment & Diagnostic procedures/ options:</u> *Eye injuries:* - Saline wash - Antibiotic ointments *Skin burns/blisters/irritation* - topical corticosteroids and/or antihistamines - Inject MgSO4 at affected site (*Hydrogen fluoride)* *Breathing/respiratory distress:* - Oxygen & ventilation - Prophylactic antibiotics - Xrays - Pulse ox/blood gas NOTE: **avoid mouth to mouth** to protect against cross contamination *Broncospasm/Pulm Edema* - Inhale corticosteroids - Beta2 agonist - Endotracheal intubation *Hemolysis (e.g. Arsine):* - IV, transfusion *Seizures:* - Diazepam
Acrolein *(colorless-yellow liq)*	Immediate	Minutes to hour	0.1 / 1.4	Poor	1 ppm -sharp, acrid, sweet	Toxic and corrosive fumes; Herbicide	#93 *(BUT high detection*)	Not standard		
Acrylonitrile *(clear/pale yellow liq)*	Immediate	Minutes to HOURS	35 / 75	Poor	17 ppm - unpleasant, sweet (peach)	Flammable gas; used in Plastics, coatings, adhesives industries; dyes; pharmaceuticals;	#191	Standard		
Ammonia *(colorless gas)*	Immediate	Minutes	110 / 1100	Poor	17 ppm - sharp,suffocating,dry urine	Explosives manufacture; pesticides; detergents industry	#3M	Standard		
Arsine *(colorless gas)*	Immediate to 24 hours	Minutes to hours	0.2 / 0.5	Good	0.5 ppm - garlic-like	Reacts with H20 (don't use H2O in fire); Used in electronics ind	#19L	Not standard		
Chlorine *(greenish-yellow gas)*	Immediate to hours	Minutes to hours	3 / 22	Good	3.5 ppm-pungent (bleach), suffocating	Irritating corr fumes; heavier than air; Cleaner/disinfectant in many industries; water treatment; WWI war gas;	#80	Not standard		
Diborane *(colorless gas)*	Immediate	Minutes to hours	>1 / 15	Good	2.5 ppm -sickly sweet	Very flammable; Intermediate chemical manufacturing;	#22	Not standard		
Ethylene oxide *(colorless gas/liq)*	Immediate	Minutes to hours	45 / 200	Poor	425 ppm - sweet, ether-like	Very flammable; Rocket propellant; fumigant; sterilization in health care industry;	#163L	Standard		
Formaldehyde *(clear- white gas/liq)*	Immediate	Hours	10 / 25	Poor	1 ppm -pungt suffocating	Flammable,Disinfection/ germicide; fungicide; textile; health care (tissue fixing)	#91D (Dosi)	Standard		
Hydrogen bromide *(pale yellow liq)*	Immediate	Minutes to hours	3 / 30	Good	2 ppm -sharp stinging	Chemical manufacturing industry; very corrosive	#15L	Not standard		
Hydrogen chloride (hydrochloric acid) *(pale yellow-colorless liq)*	Immediate	Minutes to hours	22 / 104	Good	0.77 ppm - pungent, irritating	Corrosive liquid; Ore, other metal refining/ cleaning; food/pickling; petroleum;	#80	Not standard		
Hydrogen Cyanide *(colorless-white-pale blue gas; liquid <75F)*	Immediate	MInutes	7.0 / 15-50	Good	1-5 ppm-bitter/sweet almond-like	Weak acid except in water or mucous membranes – then corrosive/irritating; used as War gas, pesticide, Herbicide; other industries	#12L	Not Standard		
Hydrogen fluoride *(colorless gas/fuming liq)*	Immediate & Delayed	Minutes to hours	24 / 44	Good	0.4 ppm - strong irritating	Corrosive liq; Aluminum and other metal industries; insecticide manufacturing-	#17	Not standard		
Hydrogen selenide *(colorless gas)*	Immediate	Minutes - Hour	0.2 / 1.5+	Poor	0.3 ppm-decayed horseradish	Highly flammable/explosive; can cause burns/frostbite; decomposes rapidly to form elemental selenium Metals &semiconductor prep;	Not available	Not standard		
Hydrogen sulfide *(colorless gas)*	Immediate & Delayed	MINUTES to hours	30 / 100	Good	0.1 ppm -rotten egg	Disinfectant lubricant/oils; interm for HC manufacture; deadens sense of smell	#44	Not standard		**See page 2 ----------→**

Chemical	Rate of Onset	Persists in Environment	Toxicity Thresholds (ppm/hour) impairment / fatality	BDO/ Mask Effective	Odor	Source/ Use/other hazard	Field Detection: Sensidyne tube (#)	Field Detection: 205Aseries Miran SapphiRE
Methyl hydrazine	Immediate & Delayed (LUNGS)	Hours - days	1.0 / 3.0	Poor?	1 –10 ppm- ammonia like	Irritating vapors; Flammable- Once ignited continues to burn; Used as solvent, rocket fuel;	#185	Not standard
Hydrazine *Colorless, oil (fuming) liquid/waxy solid or crystals*	Immediate & Delayed (LUNGS)	Hours - days	13 / 35	Poor?	3-4 ppm- Ammonia -like	Flammable- Once ignited continues to burn; irritating vapors; Used as solvent, rocket fuel;	#3D (Dosi)	Standard
Methyl isocyanate *(colorless liquid)*	Immediate	Minutes to hours	0.5 / 5	Poor	2.1 ppm -sharp pungent	Intermediate in manufacturing; reacts with H20 (don't use in fire)	Not available (liquid)	Not standard (liquid)
Methyl mercaptan *(colorless gas; liquid <43F)*	Immediate	Minutes to hours	5.0 / 23	Poor	0.002 ppm- rotten cabbage (1 ppm odor fatigue)	From decayed organic matter – pulp mills, oil refineries; highly flammable; liquid burns/frostbite	#71	Not standard
Nitrogen dioxide *(colorless gas/pale liq)*	Delayed (24-72 hrs)	MINUTES to hours	12 / 20	Poor	1 ppm - ?	Intermediate for manuf of nitric acid & sulfuric acid; explosives/rocket propellant	#9D (Dosi)	Not standard
Nitric Acid *(colorless, yellow, or red fuming liquid)*	Immediate	Hours-days +	4.0 / 22+	Poor	~1 ppm- Choking, sweet – acrid	Used in many industries; Very corrosive to skin/mucous membranes as well as metals & other materials;	#80	Not standard
Parathion *(pale yellow to brown liquid)*	Immediate but often Delayed (weeks)	Days to weeks	0.2 / 0.8	Good	0.04 ppm	Organophosphate (insecticide); similar symptoms (and thus treatment) as nerve gases; penetrates leather/canvas and plastics/rubber coatings	Not Available (liquid)	Not Available (liquid)
Phosgene *(colorless – light yellow gas)*	Immediate & Delayed (LUNGS)	Minutes - HOURS	0.3 / 0.8-5	Good	0.5ppm- musty hay	Dye, pesticide, and other industries; history as war gas, corrosive/irritating	#16	Standard
Phosphine *(colorless gas)*	Immediate & Delayed (LUNGS)	Minutes-hours	0.3 / 1.1-30	Good?	0.9 ppm- rotten fish, garlic	Insecticide; used in manufacture of flame retardants and incendiaries;	#7LA	Not Standard
Sulfuric Acid *(clear colorless- brown oily liquid)*	Immediate	Hours, days	2.5 / 7.5	Good	Odorless (acrid taste)	Toxic fumes when heated Battery/dyes/paper/glue/metals industries; volcanic gas;	Not available (liquid)	Not Available (liquid)
Sulfur dioxide; sulfur trioxide; -form sulfuric acid (*colorless gas*)	Immediate & Delayed	MINUTES to hours	>3 / 15-100	Good (SO2); Marginal (SO3)	1 ppm; pungent; metallic taste	Disinfectant and preserving in breweries and food/canning; textile industry; batteries	# 5L	Standard
Toluene diisocyanate (2,4) *(water-white to pale yellow liquid, or crystals)*	Immediate	Hours - weeks	0.08 / 0.51	Good	0.4-2 ppm- sharp pungent	Skin irritant Polyurethane (wood coatings , foam), nylon industries;	Not Available (liquid)	Not Available (liquid)

Symptoms *(from inhalation and dermal contact*

General Mild Health Effects:

- Nausea, dizziness; headaches; chills; coughing, choking, throat irritation

Specific and More Severe Effects:

Eyes:

- Irritation; tearing/watering; pain; intolerance to light (e.g. from Hydrogen Sulfide)

Skin (particularly if liquid contact):

- Irritation; burning; blisters (eg with Hydrogen Fluoride); vesiculation (nitric & sulfuric acid); dermatitis; and frostbite (e.g. Acryonitrile)

Respiratory Tract/Lungs:

- Breathing difficulty.respiratory distress; laryngeal spasm (e.g., from hydrogen chloride or hydrogen bromide); **pulmonary edema**

Chest/Heart:

- chest pain; tachardia (rapid heartbeat)

Systemic; Blood

- Cyanotic (blue skin from lack Oxy to blood) (e.g, from SO2, SO3, NO2, ethylene oxide):
- Convulsions/seizures
- Hemolytic anemia; kidney damage (Arsine) (sulfuric acid, hyrdazine)

Additional Chemical Specific Symptoms:

pink/froth sputum: Ammonia
mucoid frothy sputum: SO2,SO3, NO2
peculiar taste: Ethylene oxide
asphyxia: Acrylonitrile
metal taste & or garlic breath:Hydrogen Selenide
Miosis, sweating, ⇓ ACHe Parathion
Coffee-ground vomit – sulfur acid

Decontamination and Treatment

Decontamination:

- Flush (15 min) eyes & skin with water;
- Soap optional after initial water rinse

Treatment & Diagnostic procedures/ options:

Eye injuries:

- Saline wash
- Antibiotic ointments

Skin burns/blisters/irritation

- topical corticosteroids and/or antihistamines
- Inject MgSO4 at affected site (*Hydrogen fluoride)*

Breathing/respiratory distress:

- Oxygen & ventilation
- Prophylactic antibiotics
- Xrays
- Pulse ox/blood gas

NOTE: **avoid mouth to mouth** to protect against cross contamination

Broncospasm/Pulm Edema

- Inhale corticosteroids
- Beta2 agonist
- Endotracheal intubation

Hemolysis (e.g. Arsine):

- IV, transfusion

Seizures:

- Diazepam

Appendix C List of Excluded Bidders

The Department of Energy Laboratories listed below are excluded from responding to this solicitation:

1) Argonne National Laboratory
2) Brookhaven National Laboratory
3) DoE Remote Sensing Laboratory
4) Idaho National Engineering and Environmental Laboratory
5) Lawrence Livermore National Laboratory
6) Los Alamos National Laboratory
7) Oak Ridge National Laboratory
8) Pacific Northwest National Laboratory
9) Sandia National Laboratory

Appendix D List of Acronyms

ADP	Advanced Development Plan
ARFCAM	Autonomous Rapid Facility Chemical Agent Monitor
BAND	Bioagent Autonomous Networked Detector
BIDS	Broad Agency Announcement Information Delivery System
CAGE	Commercial and Government Entity
CDC	Centers for Disease Control
CDR	Critical Design Review
CWAs	Chemical Warfare Agents
DHS	Department of Homeland Security
DOD	Department of Defense
DOE	Department of Energy
DSBCC	Detection Systems for Biological and Chemical Countermeasures
DUNS	Data Universal Numbering System
EPA	Environmental Protection Agency
FFRDC	Federally Funded Research and Development Centers
FICE	Federal Interagency Committee on Education
G&A	General and Administrative
HBCU	Historically Black Colleges and Universities
HSARPA	Homeland Security Advanced Research Projects Agency
HUB zone	Historically Underutilized Business zone
HVAC	Heating, Ventilation & Air Conditioning
IDHL	Immediate Danger to Health and Life http://www.cdc.gov/niosh/npg/npgd0000.html

IR&D	Independent Research and Development
LACIS	Lightweight Autonomous Chemical Identification System
LOD	Limit of Detection
LRN	Laboratory Response Network
MI	Minority Institutions
NISPOM	National Industrial Security Program Operating Manual
OT	Other Transactions for Prototype
P3I	Pre-Planned Product Improvements
PCR	Polymerase Chain Reaction
PDR	Preliminary Design Review
PELs	Permissible Exposure Limits http://www.cdc.gov/niosh/npg/npgd0000.html
PHILIS	Portable High-throughput Integrated Laboratory Identification System
PPE	Physical Protective Equipment
RA	Research Announcement
RABIS	Rapid Automated Biological Identification System
SCU	Scene Control Unit
SDB	Small and Disadvantaged Businesses
SIC	Standard Industrial Classification
SOW	Statement of Work
SPA	Sample Preparation Area
TICs	Toxic Industrial Chemicals
TIN	Taxpayer Identification Number

TSWG	Technology Support Working Group
TTA	Technical Topic Area
WB	Women-owned Businesses

Model Other Transactions (OT) Agreement

Note: HSARPA is willing to negotiate terms and conditions in the Offeror's proposed agreement prior to receipt of the proposal. This negotiation may begin immediately upon receipt of proposed agreement.

OTHER TRANSACTION FOR PROTOTYPE MODEL AGREEMENT

BETWEEN (INSERT TEAM NAME AND ADDRESS)

AND

THE HOMELAND SECURITY ADVANCED RESEARCH PROJECTS AGENCY
7TH & D ST., SW
WASHINGTON, DC 20528

CONCERNING:

(*Insert name of Technical Topic Area)*
PHASE I – CONCEPT DEVELOPMENT AND SYSTEM TRADES

Agreement No.: (*Insert agreement number)*
HSARPA Order No.:
Total Estimated Government Funding of the Phase I Agreement: $
Team's Cost Share/Contribution: $
Funds Obligated: $
Authority: Section 831 of the Homeland Security Act of 2002, Public Law 107-296

Line of Appropriation: AA

This Agreement is entered into between the United States of America, hereinafter called the Government, represented by The Homeland Security Advanced Research Projects Agency (HSARPA), and the (INSERT NAME of TEAM) pursuant to and under U.S. Federal law.

FOR (INSERT TEAM NAME)	FOR THE UNITED STATES OF AMERICA THE HOMELAND SECURITY ADVANCED RESEARCH PROJECTS AGENCY
_____	_____
(Signature)	(Signature)
(Name, Title) (Date)	(Name, Title) (Date)

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ARTICLE I: SCOPE OF THE AGREEMENT

This article should state your vision for the Concept Development and System Trades phase of the HSARPA Detection Systems for Biological and Chemical Countermeasures Program and describe how your proposed program satisfies the statement of objectives. If there are dual or commercial uses of the developed technologies, be sure to include them but discuss the Government uses first.

In addition, this article should discuss the way you will interact with the HSARPA program team. Suggested wording (i.e., paragraphs used in other HSARPA Agreements) for your consideration follows:

"HSARPA will have continuous involvement with the Contractor. HSARPA will obtain access to program results and certain rights to patents and data pursuant to Articles VIII and IX. HSARPA and the Contractor are bound to each other by a duty of good faith and best effort in achieving the program objectives."

"This Agreement is an 'other transaction' pursuant to Section 831 of the Homeland Security Act of 2002, Public Law 107-296. The Parties agree that the purpose of this Agreement is to acquire the Team's best efforts in development of design concepts and trade-off studies supporting that design. The delivery of this design is a prototype within the meaning of the above-mentioned statute. The Federal Acquisition Regulation (FAR) applies only as specifically referenced herein. This Agreement is not intended to be, nor shall it be construed as, by implication or otherwise, a partnership, a corporation, or other business organization."

Terms such as "Team," "Team Members" and "program," etc. should also be defined in this article.

ARTICLE II: TERM

A. The Term of this Agreement

This Agreement commences upon the date of the last signature hereon and continues for the duration of the Concept Development and System Trades, Phase I. For planning purposes, the estimated period of performance for Phase I is date of award through 12 months. This agreement will be updated to modify the agreement for the teams entering into Phase II, Preliminary Design. Completion criteria for Phase I are defined in Article IV, Payable Event Schedule and Deliverables.

B. Termination Provisions

Subject to a reasonable determination that this agreement will not produce beneficial results commensurate with the expenditure of resources, either Party may terminate this Agreement by written notice to the other Party, provided that such written notice is preceded by consultation between the Parties. In the event of a termination of the

Agreement, it is agreed that disposition of data developed under this Agreement, shall be in accordance with the provisions set forth in Articles IX, Data Rights. The Government and Team will negotiate in good faith a reasonable and timely adjustment of all outstanding issues between the Parties as a result of termination. Failure of the Parties to agree to a reasonable adjustment will be resolved pursuant to Article VII, Disputes. The Government has no obligation to reimburse the Team beyond the last completed and paid milestone if the Team decides to terminate.

C. Extending the Term

The Parties may extend by mutual written agreement the term of this Agreement if funding availability and research opportunities reasonably warrant. Any extension shall be formalized through modification of the Agreement by the Agreements Officer and the Team Administrator.

ARTICLE III: STATEMENT OF OBJECTIVES

This article should also summarize the scope of the work and the business arrangement to which you are committing (as described in detail in this article, Statement of Objectives) by entering into this Agreement.

The Team will include here or reference here their proposed Task Description Document (TDD) in accordance with the guidance provided in the solicitation. This TDD describes the tasks that the Team must accomplish to be successful in this Concept Development and System Trades phase (Phase I). Consider the Government Phase I Statement of Objectives, the overall UCAR program goals and other guidance provided in the solicitation.

ARTICLE IV: PAYABLE EVENT SCHEDULE AND DELIVERABLES

A. Payment Schedule

The Team shall perform the work required by Article III and the TDD. The Team shall be paid for each Payable Milestone accomplished and delivered in accordance with the Schedule of Payments and Payable Milestones set forth below. The Team shall propose the accomplishment criteria for the events listed below. Both the Schedule of Payments and the Funding Schedule set forth below may be revised or modified in accordance with subparagraph C of this article.

B. Schedule of Payments and Payable Milestones

The Team shall propose a milestone schedule, accomplishment criteria and deliverables to be incorporated into this agreement. Reference Government provided criteria in solicitation as a starting point for your proposal.

C. Modifications

1. At any time during the term of the Agreement, progress or results may indicate that a change in the Statement of Objective and/or the Payable Milestones would be beneficial to the program objectives. Recommendations for modifications, including justifications to support any changes to the Statement of Objectives and/or the Payable Milestones, will be documented in a letter and submitted by the Team to the HSARPA Program Manager with a copy to the HSARPA Agreement Officer. This letter will detail the technical, chronological, and financial impact of the proposed modification to the research program. Any resultant modification is subject to mutual agreement of the parties. The Government is not obligated to pay for additional or revised Payable Milestones until the Payable Milestones Schedule is formally revised by the HSARPA Agreements Officer and made part of this Agreement.

2. The HSARPA Program Manager shall be responsible for the review and verification of milestone accomplishment criteria and any recommendations to revise or otherwise modify the Agreement Statement of Objectives, Schedule of Payments and Payable Milestones, or other proposed changes to the terms and conditions of this Agreement.

3. For minor or administrative Agreement modifications (e.g., changes in the paying office or appropriation data, changes to Government or Team personnel identified in the Agreement, etc.), HSARPA shall make these types of changes unilaterally

4. The Government will be responsible for effecting all modifications to this agreement.

ARTICLE V: AGREEMENT ADMINISTRATION

Administrative and contractual matters under this Agreement shall be referred to the following representatives of the parties:

HSARPA: (*Name will be inserted)*Agreements Officer, Tel: (*Number will be inserted)*
Team: (INSERT NAME) (INSERT TITLE) (INSERT TELEPHONE NUMBER)

Technical matters under this Agreement shall be referred to the following representatives:

HSARPA: (*Name will be inserted)*, Program Manager, Tel: (*Number will be inserted)*

Team: (INSERT NAME) (INSERT TITLE) (INSERT TELEPHONE NUMBER)

Either party may change its representatives named in this Article by written notification to the other party. The Government will effect the change as stated in subparagraph C.4 of Article IV above.

ARTICLE VI: OBLIGATION AND PAYMENT

A. Obligation

The Government's liability to make payments to the Team is limited to only those funds obligated under this Agreement or by amendment to the Agreement. HSARPA may obligate funds to the Agreement incrementally.

B. Payments

1. The following information shall be included on each invoice:

    Agreement Number
    Invoice Number
    A description of services performed
    Quantity of service received or performed
    The time of period covered by the invoice
    Terms of Payment
    Payment Office
    Amount claimed

2. The Team shall document each Payable Milestone by submitting deliverables in accordance with the Payable Milestone Schedule and Accomplishment Criteria. The Team shall submit an original and one (1) copy of all invoices to the Agreements Officer for payment approval. After written verification of the accomplishment of the Payable Milestone by the HSARPA Program Manager, and approval by the Agreements Officer, the invoices will be forwarded to the payment office within fifteen (15) calendar days of receipt of the invoices at HSARPA. Payment approval for the final Payable Milestone will be made after reconciliation. Payments will be made by (*appropriate paying office will be inserted at time of award)* within fifteen (15) calendar days of HSARPA's transmittal. Subject to change only through written Agreement modification, payment shall be made via electronic funds transfer to the Contractor's address set forth below:

3. Bank Account of Payee:

    Bank:
    Address:
    Routing Transit Number:
    Depositor Account Title:
    Depositor Number:

4. Financial Records and Reports: The Team's relevant financial records associated with this Agreement are not subject to examination or audit by the Government, except as noted below, since the confirmed accomplishment of the appropriate milestone completes the obligation of both parties.

5. Comptroller General Access to Records: To the extent that the total government payments under this Agreement exceed $5,000,000, the Comptroller General, at its discretion, shall have access to and the right to examine records of any party to the agreement or any entity that participates in the performance of this agreement that directly pertain to and involve transactions relating to, the agreement for a period of three (3) years after final payment is made. This requirement shall not apply with respect to any party to this agreement or any entity that participates in the performance of the agreement, or any subordinate element of such party or entity, that has not entered into any other agreement (contract, grant, cooperative agreement, or "other transaction") that provides for audit access by a government entity in the year prior to the date of this agreement. This paragraph only applies to any record that is created or maintained in the ordinary course of business or pursuant to a provision of law. The terms of this paragraph shall be included in all sub-agreements to the Agreement.

ARTICLE VII: DISPUTES

A. General

The Parties shall communicate with one another in good faith and in a timely and cooperative manner when raising issues under this Article.

B. Dispute Resolution Procedures

1. Any disagreement, claim or dispute between the Government and the Team concerning questions of fact or law arising from or in connection with this Agreement, and, whether or not involving an alleged breach of this Agreement, may only be raised under this Article.

2. Whenever disputes, disagreements, or misunderstandings arise, the Parties shall attempt to resolve the issue(s) involved by discussion and mutual agreement as soon as practicable. In no event shall a dispute, disagreement or misunderstanding which arose more than three (3) months prior to the notification made under subparagraph B.3 of this Article constitute the basis for relief under this article unless the Director of HSARPA in the interests of justice waives this requirement.

3. Failing resolution by mutual Agreement, the aggrieved Party shall document the dispute, disagreement, or misunderstanding by notifying the other Party (through the HSARPA Agreements Officer) in writing of the relevant facts, identify unresolved issues, and specify the clarification or remedy sought. Within five (5) working days after providing notice to the other Party, the aggrieved Party may, in writing, request a joint decision by the HSARPA Deputy Director, and Representative of the Team (“Team

Representative"). The other Party shall submit a written position on the matter(s) in dispute within thirty (30) calendar days after being notified that a decision has been requested. The HSARPA Deputy Director and the Team Representative shall conduct a review of the matter(s) in dispute and render a decision in writing within thirty (30) calendar days of receipt of such written position. Any such joint decision is final and binding.

4. In the absence of a joint decision, upon written request to the Director of HSARPA, made within thirty (30) calendar days or upon unavailability of a joint decision under subparagraph B.3 above, the dispute shall be further reviewed. The Director of HSARPA may elect to conduct this review personally or through a designee or jointly with a representative of the other Party who is a senior official of the Party. Following the review, the Director of HSARPA or designee will resolve the issue(s) and notify the Parties in writing. Such resolution is not subject to further administrative review and, to the extent permitted by law, shall be final and binding.

ARTICLE VIII: PATENT RIGHTS

A. Definitions

1. "Invention" means any invention or discovery which is or may be patentable or otherwise protectable under Title 35 of the United States Code.

2. "Made" when used in relation to any invention means the conception or first actual reduction to practice of such invention.

3. "Practical application" means to manufacture, in the case of a composition of product; to practice, in the case of a process or method, or to operate, in the case of a machine or system; and, in each case, under such conditions as to establish that the invention is capable of being utilized and that its benefits are, to the extent permitted by law or Government regulations, available to the public on reasonable terms.

4. "Subject invention" means any invention of a Team Member conceived or first actually reduced to practice in the performance of work under this Agreement.

B. Allocation of Principal Rights

The Team shall retain the entire right, title, and interest throughout the world to each subject invention consistent with this Article and 35 U.S.C. § 202. With respect to any subject invention in which the Team retains title, HSARPA shall have a non-exclusive, nontransferable, irrevocable, paid-up license to practice or have practiced on behalf of the United States the subject invention throughout the world. Notwithstanding the above, the Team may elect to provide full or partial rights that it has retained to Team Members or other parties.

C. Action to Protect the Government's Interest

1. The Team agrees to execute or to have executed and promptly deliver to HSARPA all instruments necessary to (i) establish or confirm the rights the Government has throughout the world in those subject inventions to which the Consortium elects to retain title and to enable the Government to obtain patent protection throughout the world in that subject invention.

2. The Team shall include, within the specification of any United States patent application and any patent issuing thereon covering a subject invention, the following statement: "This invention was made with Government support under Agreement No. (*agreement number will be inserted at time of award)* awarded by HSARPA. The Government has certain rights in the invention."

D. Lower Tier Agreements

The Team shall include this Article, suitably modified, to identify the Parties, in all subcontracts or lower tier agreements, regardless of tier, for experimental, development, or research work.

E. Reporting on Utilization of Subject Inventions

The Team agrees to submit a final report on the utilization of a subject invention or on efforts at obtaining such utilization that are being made by the Team or its licensees or assignees. The report shall include information regarding the status of development, date of first commercial sale or use, gross royalties received by the Team subcontractor(s), and such other data and information as the agency may reasonably specify. The Team also agrees to provide additional reports as may be requested by HSARPA in connection with any march-in proceedings undertaken by HSARPA in accordance with paragraph G of this Article. Consistent with 35 U.S.C. § 202(c)(5), HSARPA agrees it shall not disclose such information to persons outside the Government without permission of the Team.

F. Preference for American Industry

Notwithstanding any other provision of this Article, the Team agrees that it shall not grant to any person the exclusive right to use or sell any subject invention in the United States or Canada unless such person agrees that any product embodying the subject invention or produced through the use of the subject invention shall be manufactured substantially in the United States or Canada. However, in individual cases, the requirements for such an agreement may be waived by HSARPA upon a showing by the Team that reasonable but unsuccessful efforts have been made to grant licenses on similar terms to potential licensees that would be likely to manufacture substantially in the United States or that, under the circumstances, domestic manufacture is not commercially feasible.

G. March-in Rights

The Team agrees that, with respect to any subject invention in which it has retained title, HSARPA has the right to require the Team, an assignee, or exclusive licensee of a subject invention to grant a non-exclusive license to a responsible applicant or applicants, upon terms that are reasonable under the circumstances, and if the Team, assignee, or exclusive licensee refuses such a request, HSARPA has the right to grant such a license itself if HSARPA determines that:

1. Such action is necessary because the Team or assignee has not taken effective steps, consistent with the intent of this Agreement, to achieve practical application of the subject invention;

2. Such action is necessary to alleviate health or safety needs that are not reasonably satisfied by the Team, assignee, or their licensees;

3. Such action is necessary to meet requirements for public use and such requirements are not reasonably satisfied by the Team, assignee, or licensees; or

4. Such action is necessary because the agreement required by paragraph (I) of this Article has not been obtained or waived or because a licensee of the exclusive right to use or sell any subject invention in the United States is in breach of such Agreement.

ARTICLE IX: DATA RIGHTS

Government Purpose Rights in all data delivered under this Concept Development and System Trades phase (Phase I) agreement is for this phase. The following standard Government Data Rights Article is offered as a point of departure in this case.

A. Definitions

1. "Government Purpose Rights", as used in this article, means rights to use, duplicate, or disclose Data, in whole or in part and in any manner, for Government purposes only, and to have or permit others to do so for Government purposes only.

2. "Unlimited Rights", as used in this article, means rights to use, duplicate, release, or disclose, Data in whole or in part, in any manner and for any purposes whatsoever, and to have or permit others to do so.

3. "Data", as used in this article, means recorded information, regardless of form or method of recording, which includes but is not limited to, technical data, software, trade secrets, and mask works. The term does not include financial, administrative, cost,

pricing or management information and does not include subject inventions included under Article VIII.

4. “Limited rights” as used in this article means the rights to use, modify, reproduce, release, perform, display, or disclose technical data, in whole or in part, within the Government. The Government may not, without the written permission of the party asserting limited rights, release or disclose the data outside the Government, use the technical data for manufacture, or authorize the technical data to be used by another party.

B. Allocation of Principal Rights

1. This Agreement is performed with mixed Government and Team funding. The Parties agree that in consideration for Government funding, the Team intends to reduce to practical application items, components and processes developed under this Agreement.

2. The Team agrees to retain and maintain in good condition until (INSERT NUMBER OF YEAR) (___) years after completion or termination of this Agreement, all Data necessary to achieve practical application. In the event of exercise of the Government's March-in Rights as set forth under Article VIII or subparagraph B.3 of this article, the Team, acting through its Team Lead, agrees, upon written request from the Government, to deliver at no additional cost to the Government, all Data necessary to achieve practical application within sixty (60) calendar days from the date of the written request. The Government shall retain Unlimited Rights, as defined in paragraph A above, to this delivered Data.

3. The Team agrees that, with respect to data necessary to achieve practical application, HSARPA has the right to require the Team to deliver all such data to HSARPA in accordance with its reasonable directions if HSARPA determines that:

(a) Such action is necessary because the Team or assignee has not taken effective steps, consistent with the intent of this Agreement, to achieve practical application of the technology developed during the performance of this Agreement;

(b) Such action is necessary to alleviate health or safety needs which are not reasonably satisfied by the Team, assignee, or their licensees; or

(c) Such action is necessary to meet requirements for public use and such requirements are not reasonably satisfied by the Team, assignee, or licensees.

4. With respect to data delivered pursuant to Attachment 3, Reports (and listed below), the Government shall receive Government Purpose Rights, as defined in paragraph A above. With respect to all Data delivered, in the event of the Government's exercise of its right under subparagraph B.2 of this article, the Government shall receive Unlimited Rights.

C. Marking of Data

Pursuant to paragraph B above, any data delivered under this Agreement shall be marked with the following legend:

> "Use, duplication, or disclosure is subject to the restrictions as stated in Agreement (*appropriate agreement number will be inserted at time of award)* between the Government and the Team."

D. Lower Tier Agreements

The Team shall include this Article, suitably modified to identify the Parties, in all subcontracts or lower tier agreements, regardless of tier, for experimental, developmental, or research work.

ARTICLE X: FOREIGN ACCESS TO TECHNOLOGY

(NOTE: It is HSARPA's intention to restrict this technology from flowing overseas without approval to ensure the economic and security issues have been resolved prior to any release. If the offerors desire proposed changes to this article they should explain the rationale completely.)

This Article shall remain in effect during the term of the Agreement and for five years thereafter.

A. Definitions

"Foreign Firm or Institution" means a firm or institution organized or existing under the laws of a country other than the United States, its territories, or possessions. The term includes, for purposes of this Agreement, any agency or instrumentality of a foreign government; and firms, institutions or business organizations that are owned or substantially controlled by foreign governments, firms, institutions, or individuals.

"Know-How" means all information including, but not limited to discoveries, formulas, materials, inventions, processes, ideas, approaches, concepts, techniques, methods, software, programs, documentation, procedures, firmware, hardware, technical data, specifications, devices, apparatus and machines.

"Technology" means discoveries, innovations, Know-How and inventions, whether patentable or not, including computer software, recognized under U.S. law as intellectual creations to which rights of ownership accrue including, but not limited to, patents, trade secrets, maskworks, and copyrights developed under this Agreement.

B. General

The Parties agree that research findings and technology developments in (*INSERT TYPE OF TECHNOLOGY*) technology may constitute a significant enhancement to the homeland security, and to the economic vitality of the United States. Accordingly, access to important technology developments under this Agreement by Foreign Firms or Institutions must be carefully controlled. The controls contemplated in this Article are in addition to, and are not intended to change or supersede, the provisions of the International Traffic in Arms Regulation (22 CFR pt. 121 et seq.), the DoD Industrial Security Regulation (DoD 5220.22-R) and the Department of Commerce Export Regulation (15 CFR pt. 770 et seq.)

C. Restrictions on Sale or Transfer of Technology to Foreign Firms or Institutions

1. In order to promote the homeland security interests of the United States and to effectuate the policies that underlie the regulations cited above, the procedures stated in subparagraphs C.2, C.3, and C.4 below shall apply to any transfer of Technology. For purposes of this paragraph, a transfer includes a sale of the company, and sales or licensing of Technology. Transfers do not include:

(a) sales of products or components, or

(b) licenses of software or documentation related to sales of products or components, or

(c) transfer to foreign subsidiaries of the Contractor for purposes related to this Agreement, or

(d) transfer which provides access to Technology to a Foreign Firm or Institution which is an approved source of supply or source for the conduct of research under this Agreement provided that such transfer shall be limited to that necessary to allow the firm or Institution to perform its approved role under this Agreement.

2. The Team shall provide timely notice to the Government of any proposed transfers from the Team of technology developed with Government funding under this Agreement to Foreign Firms or Institutions. If the Government determines that the transfer may have adverse consequences to the national security interests of the United States, the Team, its vendors, and the Government shall jointly endeavor to find alternatives to the proposed transfer which obviate or mitigate potential adverse consequences of the transfer but which provide equivalent benefits to the Team.

3. In any event, the Team shall provide written notice to the HSARPA Program Manager and Agreements Officer of any proposed transfer to a foreign firm or institution at least sixty (60) calendar days prior to the proposed date of transfer. Such notice shall cite this Article and shall state specifically what is to be transferred and the general terms of the transfer. Within thirty (30) calendar days of receipt of the Team's written notification, the HSARPA Agreements Administrator shall advise the Team whether it consents to the proposed transfer. In cases where the Government does not concur or sixty (60) calendar days after receipt and the Government provides no decision, the Team may utilize the procedures under Article VII, Disputes. No transfer shall take place until a decision is rendered.

4. Except as provided in subparagraph C.1 above and in the event the transfer of Technology to Foreign Firms or Institutions is not approved by the Government, the Team shall (a) refund to the Government funds paid for the development of the Technology and (b) negotiate a license with the Government to the Technology under terms that are reasonable under the circumstances.

D. Lower Tier Agreements

The Team shall include this Article, suitably modified, in all subcontracts or lower tier Agreements, for experimental, developmental, or research work.

ARTICLE XI: CIVIL RIGHTS ACT

This Agreement is subject to the requirements of Title VI of the Civil Rights Act of 1964 as amended (42 U.S.C. 2000-d) relating to nondiscrimination in employment.

ARTICLE XII: GOVERNMENT FURNISHED EQUIPMENT PROPERTY, INFORMATION FACILITIES AND SERVICES

The following Government Equipment property, information facilities, and services shall be provided upon the written approval of the cognizant contracting officers:

(Offeror will list all desired GFE, GFP, GFI, GFF, and GFS.)

ARTICLE XIII: SECURITY

This program shall be provided protection as required by the appropriate security requirements required by the (*appropriate DHS Security form name and number will be inserted at time of award)* (Attachment 2; *to be provided by HSARPA*) and the program security classification guide

ARTICLE XIV: OPTIONAL FUTURE PHASES

The government reserves the right to modify this agreement to include terms and conditions for Phase II and Phase III. The cost, technical content and duration of these additional periods shall be subject to negotiation between the parties. The parameters associated with Phase II shall be negotiated and agreed to prior to completion of Phase I.

ATTACHMENTS

ATTACHMENT 1 TASK DESCRIPTION DOCUMENT (TDD) OR STATEMENT OF WORK (SOW)

ATTACHMENT 2 APPROPRIATE DHS SECURITY DOCUMENTATION